Foundations of Modern Networking

SDN, NFV, QoE, IoT, and Cloud

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Chapter 2

Requirements and Technology

Types of Network and Internet Traffic

- Elastic Traffic
  - Can adjust, over wide ranges, to changes in delay and throughput across an internet and still meet the needs of its applications
  - Is the traditional type of traffic supported on TCP/IP based internets
  - Is the type of traffic for which internets were designed
  - Applications that generate such traffic typically use Transmission Control Protocol (TCP) or User Datagram Protocol (UDP) as a transport protocol

Types of Network and Internet Traffic

- Inelastic Traffic
  - Does not easily adapt, if at all, to changes in delay and throughput across an internet
  - Examples of inelastic traffic include: multimedia transmission such as voice and video, and high-volume interactive traffic
  - Requirements may include:
    - Throughput
      - A minimum throughput value may be required
    - Delay
      - Also called latency
    - Delay jitter
      - The magnitude of delay variation is a critical factor in real-time applications

Table 2.1 Service Class Characteristics

Application Category	Service Class	Traffic Characteristics	Tolerance to		
			Loss	Delay	Jitter
Control	Network control	Variable-size packets, mostly inelastic short messages, but traffic can also burst (BGP)	Low	Low	Yes
	OA&M	Variable-size packets, elastic and inelastic flows	Low	Medium	Yes
Media-Oriented	Telephony	Fixed-size small packets, constant emission rate, inelastic and low-rate flows	Very low	Very low	Very low
	Real-time interactive	RTP/UDP streams, inelastic, mostly variable rate	Low	Very low	Low
	Multimedia conferencing	Variable-size packets, constant transmit interval, rate adaptive, reacts to loss	Low-medium	Very low	Low
	Broadcast video	Constant and variable rate, inelastic, non-bursty flows	Very low	Medium	Low
	Multimedia Streaming	Variable-size packets, elastic with variable rate	Low-medium	Medium	Yes
Data	Low-latency data	Variable rate, bursty short-lived elastic flows	Low	Low-medium	Yes
	High-throughput data	Variable rate, bursty long-lived elastic flows	Low	Medium-high	Yes
	Low-priority data	Non-real-time and elastic	High	High	Yes
Best effort	Standard	A bit of everything	Not specified		

BGP = Border Gateway Protocol
OA&M = operations, administration, and management
RTP = Real-Time Transport Protocol
UDP = User Datagram Protocol

Table 2.2 QoS Requirements by Application Class

Voice	One-way latency ≤ 150 ms. One-way peak-to-peak jitter ≤ 30 ms. Per-hop peak-to-peak jitter ≤ 10 ms. Packet loss ≤ 1 percent.
Broadcast video	Packet loss ≤ 0.1 percent.
Real-time interactive video	One-way latency ≤ 200 ms. One-way peak-to-peak jitter ≤ 50 ms. Per-hop peak-to-peak jitter ≤ 10 ms. Packet loss ≤ 0.1 percent
Multimedia conferencing	One-way latency ≤ 200 ms. Packet loss ≤ 1 percent.
Multimedia streaming	One-way latency ≤ 400 ms. Packet loss ≤ 1 percent.

Real-Time Traffic Characteristics

- An example of inelastic traffic
- Are concerned with timing issues as well as packet loss
- In most cases there is a requirement that data be delivered at a constant rate equal to the sending rate
- In other cases a deadline is associated with each block of data, such that the data are not usable after the deadline has expired

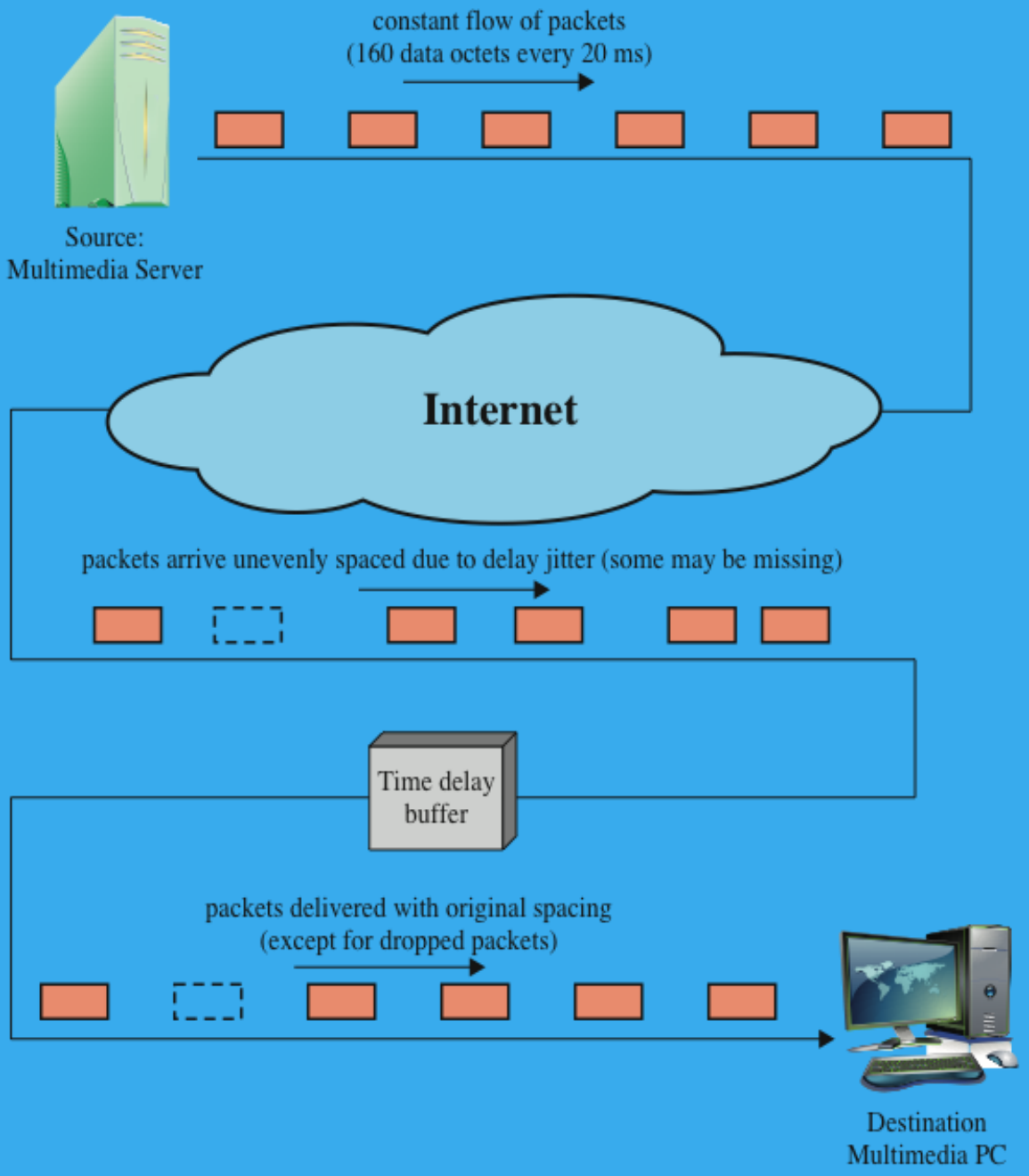


Figure 2.1 Real-Time Traffic

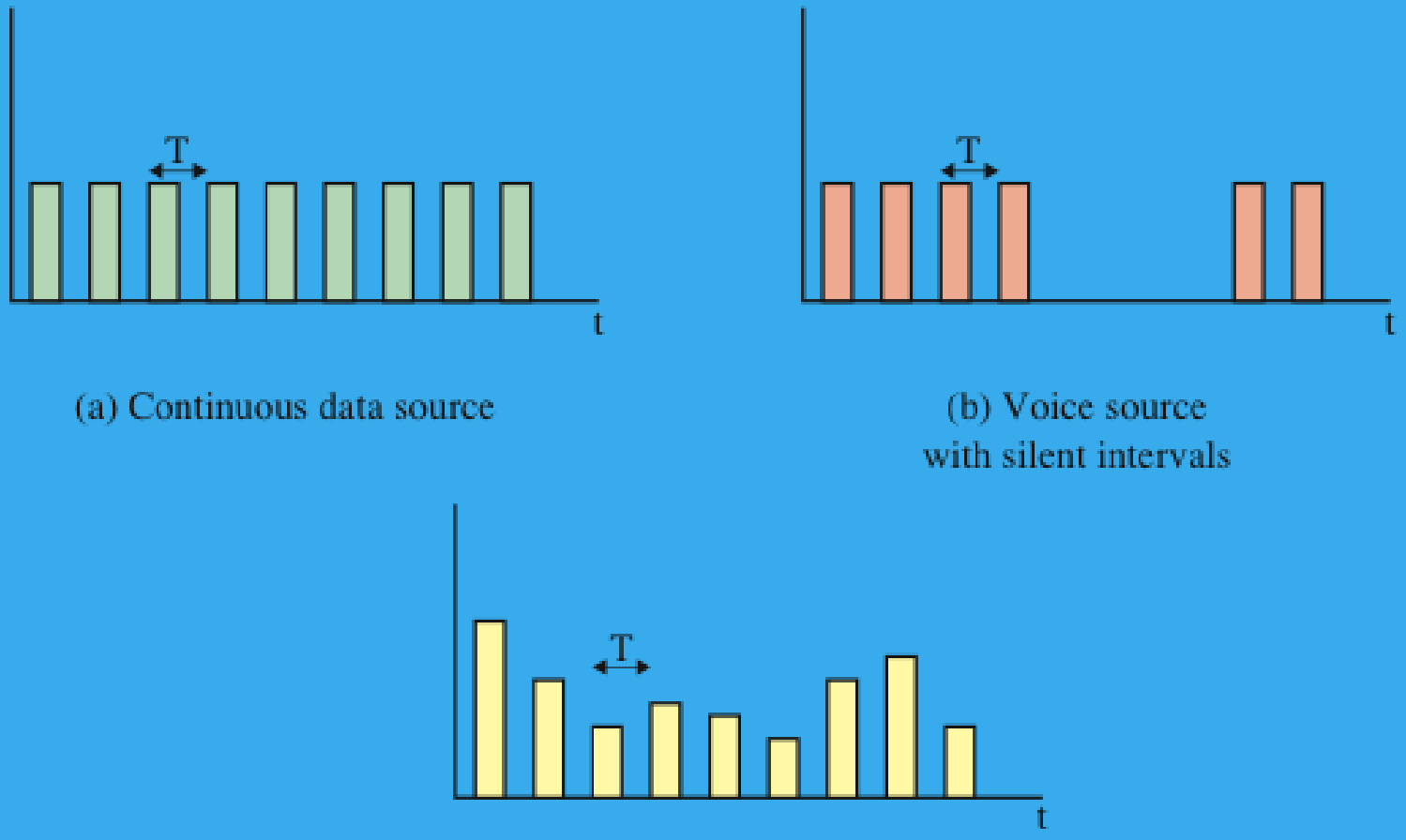


Figure 2.2 Real-Time Packet Transmission

Big Data

- Refers to everything that enables an organization to create, manipulate, and manage very large data sets and the facilities in which these are stored
- Infrastructure
  - Rational database management systems (RDBMS)
  - Network-attached storage (NAS)
  - Storage area networks (SANs)
  - Data warehouses (DWs)
  - Business intelligence (BI) analytics

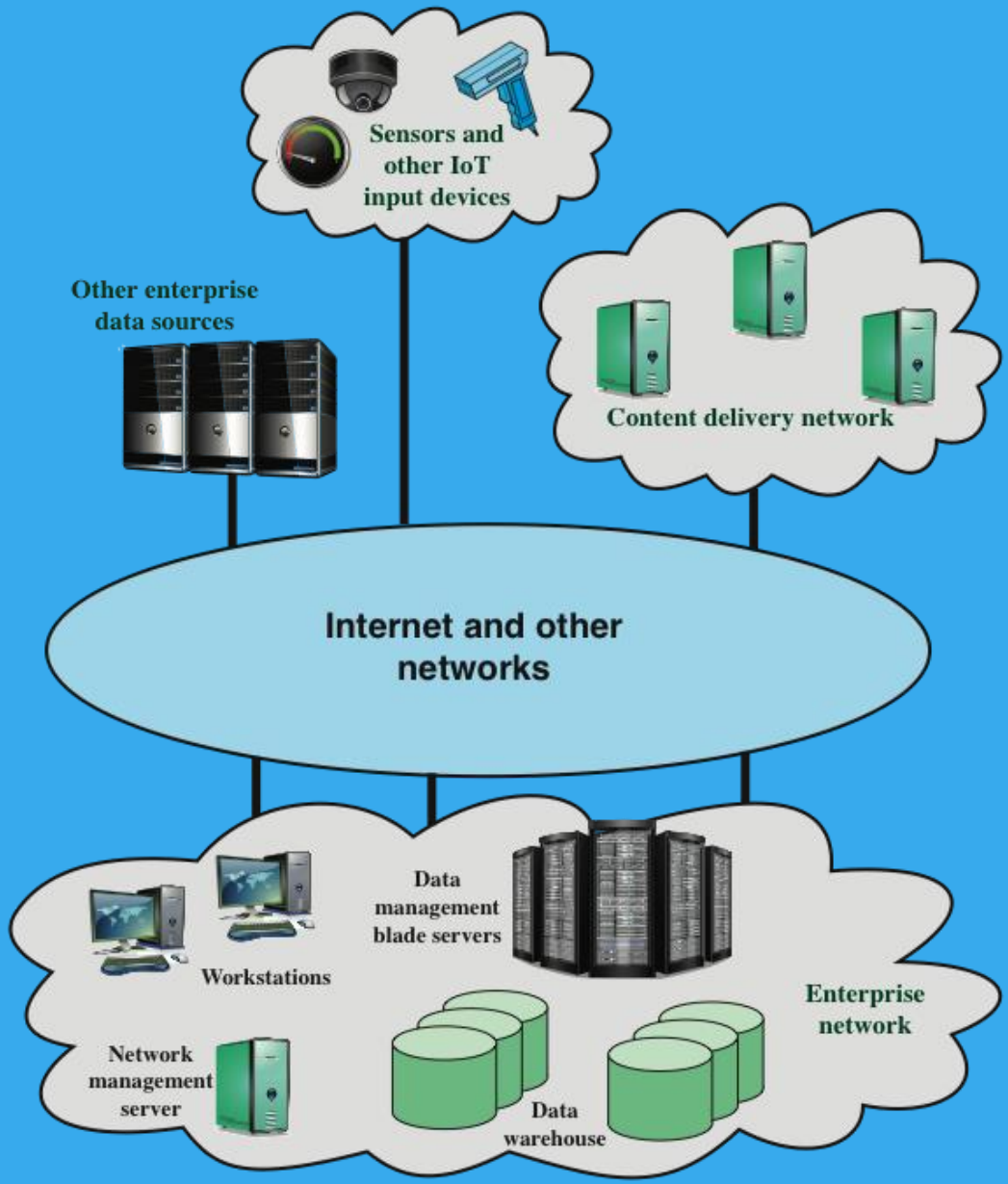
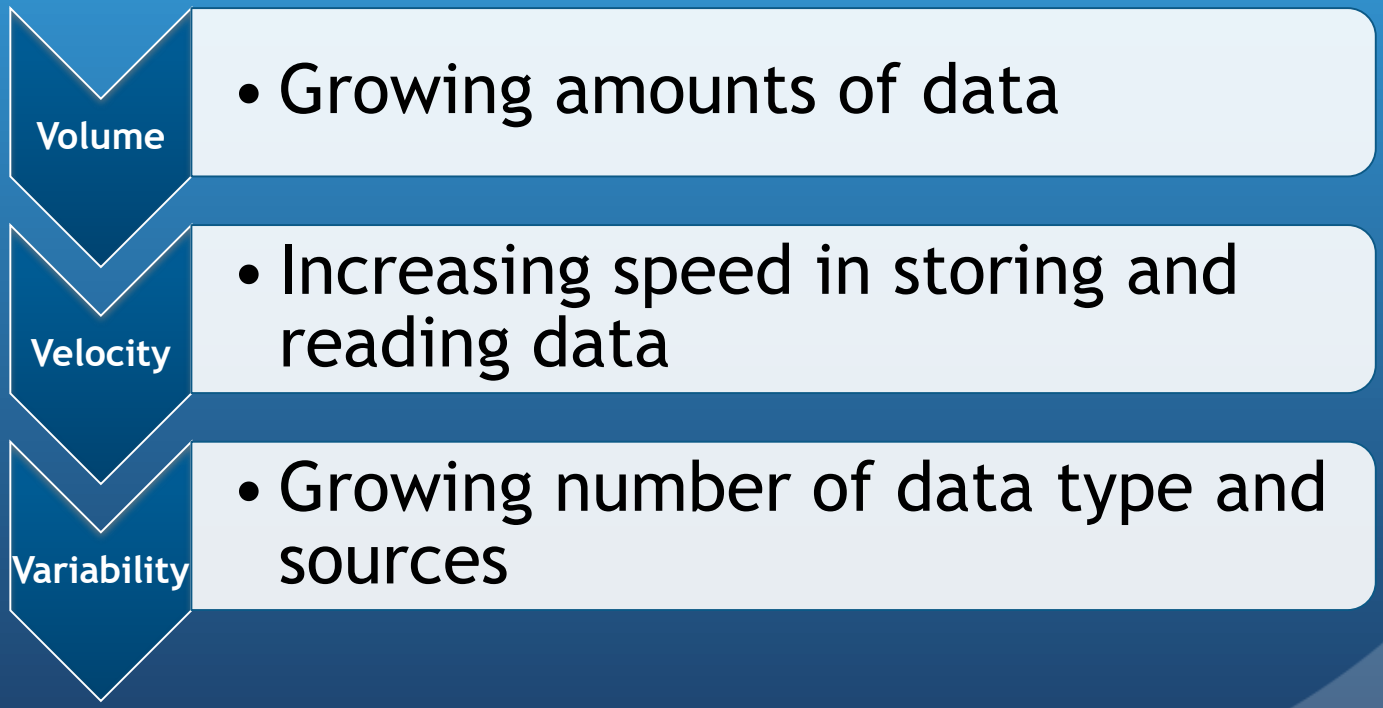


Figure 2.3 A Big Data Networking Ecosystem

Big Data

- The impact of big data on an enterprise's networking infrastructure is driven by the so-called three V's:



Areas of Concern:

Network capacity	Latency	Storage capacity	Processing	Secure data access
• Running big data analytics requires a lot of capacity on its own; the issue is magnified when big data and day-to-day application traffic are combined over an enterprise network	• The real or near-real-time nature of big data demands a network architecture with consistent low latency to achieve optimal performance	• Massive amounts of highly scalable storage are required to address the insatiable appetite of big data, yet these resources must be flexible enough to handle many different data formats and traffic loads	• Big data can add significant pressure on computational memory and storage systems, which, if not properly addressed, can negatively impact operational efficiency	• Big data projects combine sensitive information from many sources like customer transactions, GPS coordinated, video streams, and so on, which must be protected from unauthorized access